

INTRODUCTION

There are millions of substances in the world that are made up of elements. For the convenience of the study, these elements are further divided into Metals, Non-Metals, Metalloids and Noble Gases based on certain properties. Metalloids shows both the properties of metals and non-metals whereas noble gases are unreactive in nature. In this chapter we would focus on Metals and Non-Metals.

METALS

- Metals are the elements that are shiny in appearance and have a significant role in our daily life.
- They certainly constitute the mineral nature of a country.
- Most of the metals like Iron, Gold, Silver, Aluminium and calcium etc are known to us.

OCCURANCE OF METALS

- Metals occur in the nature in both the free and in the combined state.
- Non-Reactive and low reactive metals like Gold, Silver and Copper etc. occur in the free state in the nature.
- Metals like sodium, potassium and calcium etc. occur in the combined state.
- Aluminium is the most abundant metal present in the Earth crust (8%)

NON-METALS

- Non-Metals are non-shiny in appearance and are very less in number.
- Excluding the noble gases, there are only eleven non-metals known to us.
- Various non-metals are Hydrogen, Oxygen, Nitrogen, fluorine, Chlorine, Bromine, Iodine, Sulphur, Carbon, Phosphorous and astatine.



- We need oxygen for breathing and for respiration. Plants need Carbon dioxide for photosynthesis.

OCCURANCE OF NON-METALS

- ✓ Non-Metals occurs in the atmosphere both in the free state as well as in the combined state.
- ✓ Oxygen and nitrogen occur in the free state. At the same time oxygen occur in carbon dioxide and water in the combined state.
- ✓ Non-Metals occur in the combined state in the Earth's crust as carbonates, oxides, sulphates and nitrates etc.
- ✓ Nitrogen, the most abundant non-metals (78%) present in the free state and also in the combined state in food nutrients and proteins.

COMPARISION BETWEEN METALS AND NON-METALS

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Sr. No.	Property	Metals	Non-Metals
1	Physical State	Metals are solid at room temperature. Except mercury and gallium.	Non-metals generally exist as solids and gases, except Bromine.
2	Melting and boiling points	Metals generally have high m.pt and b.pt except gallium and cesium.	Non-metals have low m.pt and b.pt except diamond and graphite.
3	Density	Generally high.	Generally low.
4	Malleability and Ductility	Malleable and ductile.	Neither malleable nor ductile.
5	Electrical and thermal conductivity	Good conductors of heat and electricity.	Generally poor conductors of heat and electricity except graphite.
6	Luster	Poses shining luster.	Do not have luster except iodine.
7	Sonorous sound	Give sonorous sound when struck.	Does not give sonorous sound.
8	Hardness	Generally hard except Na, K	Solid non-metals are generally soft except diamond.

CORROSION IN METALS

- Corrosion is defined as the eating away of the metal surface when exposed to moisture, air and chemicals
- For example, Iron when exposed to moisture, forms a reddish-brown layer called as Rust ($\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$)
- Similarly, copper when exposed to moist air form a green coating of basic copper carbonate.

RUSTING OF IRON

- Rusting of iron is a special corrosion in which iron slowly reacts with moist air to produce a reddish-brown substance called as Rust.
- Rust has the formula of $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (Hydrated Ferric Oxide)



- Rusting can be expressed in the form of chemical reaction as follows: -
- Iron + Oxygen $\xrightarrow{\text{Moisture}}$ Hydrated Ferric Oxide
- $4\text{Fe} + 3\text{O}_2 \xrightarrow{x.\text{H}_2\text{O}} 2\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$

(Slow Process)

CONDITION FOR RUSTING

- Air
- Moisture
- The presence of acidic gases like carbon dioxide, Sulphur dioxide, Sulphur trioxide and Nitrogen Dioxide

PREVENTION FROM RUSTING



BY PAINTING

- *Painting with red lead*
- *Oil paint*
- *Enamel coating*
- *Coal tar*
- *Plastic coating*

Greasing or Oiling

METALLIC COATING

- **Galvanization**-The process in which metals are coated with Zinc. Galvanization is used iron articles like roof sheds, buckets, and tubs etc. Water pipes after galvanization are known as G.I pipes. Galvanized steel is not used for food containers as acids present in the food reacts with zinc



to form poisonous substances.

- *Tin Plating*
- *Aluminium plating*
- *Alloy formation*
- *Electroplating*-The coating of superior metal over an inferior metal by the passage of electricity is called electroplating.

The Iron Pillar near Qutab Minar is rust resistant as it is made of iron mixed with phosphorous that made it lasting since last eight hundred years without rusting

USES OF SOME METALS

GOLD (Au)

- Used in the manufacturing of electronic devices like computers, telephone and home appliances etc.
- Used in making ornaments and coins.
- Used in filling the teeth cavities in the form of an alloy (amalgam) which is a mixture of Gold and Silver along with mercury.

SILVER (Ag)

- Making Jewellery.

- Filling teeth cavities.
- As a purifier of water.
- As an electrode.
- In electroplating
- In decorating the sweets.

IRON (Fe)

- Making pipes, tanks, nails and furniture etc.
- Used in the construction of power transmission towers.
- Used for making Buildings, Bridges and Ships etc.
- Used in making utensils, cutlery and surgical instruments from its alloy stainless steel which is a mixture of Iron and chromium

COPPER (Cu)

- Used in making wires, coils and cables
- Used in making coins and statues (Bronze and brass)
- Used in making electronic devices.

ALUMINIUM (Al)

- In making electrical wires
- In making utensils and cans for drinks.
- As a paint to prevent rust on telephone poles.
- For packing foodstuff and medicines.

ZINC (Zn)

- As an electrode metal.
- For making alloys like brass and bronze
- For galvanization
- For making Dry cells

MERCURY (Hg)

- In thermometers
- In barometers
- In dentistry

TIN (Sn)

- For making tin cans for storing food
- Tin coated iron sheets are used to make boxes and big containers.

MAGNESIUM (Mg)

- In fireworks
- In making alloys like magnalium and duralumin

LEAD (Pb)

- Making Storage batteries.
- Making sanitary pipes, tips of bullets and fusible alloy (Solder- a mixture of 50% tin and 50% lead)

PLATIMNUM (Pt)

- For making electrodes and electrolytic cells.

- For making expensive ornaments and watches.
- As a catalyst in the hydrogenation of unsaturated oils to make “ghee”

TUNGSTEN (W)

- Making electrodes
- Making heating elements
- In mining industries
- In electric bulb filament and cathode ray tubes.

USES OF SOME NON-METALS

OXYGEN (O₂)

- Used during breathing and Respiration by human beings and animals
- Used in industries
- It is important for combustion
- Used in the hospitals

NITROGEN (N₂)

- Used in packaging of chips packets
- Used in electrical bulbs
- Used in preparing fertilizers like urea

CARBON (C)

COAL

- Used as a fuel in the industries and home.
- Used in the pharmaceutical and textile sectors, as a source of synthetic



chemicals.

GRAPHITE

- Used as pencil leads.
- As electrode
- As a solid Lubricants
- In nuclear reactors
- Used for making heat resistant crucibles.

DIAMOND

- Used in ornaments
- In glass cutting

CHARCOAL

- Used as a decolourising agent in the sugar industries.
- Used to purify water as it removes the colour and smell if present in the water.

IODINE (I₂)

- Used in salts
- Used in photographic films in the form of potassium Iodide
- Used in making Tincture of iodine and Iodex. Tincture of Iodine is a mixture of Iodine and alcohol

CHLORINE (Cl₂)

- Used as bleaching agent
- Used as a disinfecting agent for drinking water and swimming pool
- Used in the manufacture of DDT (Dichlorodiphenyl trichloro ethane) and BHC (Benzene hexachloride)
- Used in making Hydrochloric acid
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HYDROGEN (H₂)

- Used as a reducing agent
- Used in making ammonia
- Used in converting vegetable oil to "ghee"

SULPHUR (S)

- Used as fungicides and insecticides
- Used in making antibiotics
- Used in match box industries in making the striking heads (Phosphorous Sulphide)
- Used to vulcanize the rubber.

METALLOIDS

Metalloids are the elements that show both the properties of metals and non-metals. Some of the examples of metalloids are Silicon, boron, arsenic and antimony etc.

SILICON (Si)

- Highly pure silicon is used in making microchips for computers, transistors and the electronic devices present in the space age industries.



- It is used in making "silicone" which is used in making water proof bags , umbrellas and raincoats.
- Used in making electrical steel.
- Used in making concrete, bricks and cement in the form of sand.
- **In the form of silicates, it is used in making enamel, pottery.**

GERMANIUM (Ge)

- Used as a Semiconductor.
- Used in transistor mixing with arsenic and gallium etc.
- Used to form alloys and as a phosphor in fluorescent lamps.

ANTIMONY (Sb)

- Used in making Semiconductor devices
- It is used in printing press as type metal
- Used in making paints, enamels and glass pottery.

INERT GASES

These are the chemically non-reactive elements. They are found only in traces. They are six in number. They are Helium, Argon, Neon, Xenon, Radon, Krypton.

- **Helium** is used for filling up weather observation balloons.
- **Argon** is used for filling electric bulbs so as to provide an inert atmosphere.
- **Neon** is used in making advertising signboards and tube lights.
- Radon is only radioactive inert gas for cancer treatment.
- **Xenon** and krypton are used in photography.



